DECLARATION

I, James G. Morgan, a British subject of Markgrafenstr. 8, 81827 Munich, West Germany, do hereby declare that I am conversant with the English and German languages and that I am a competent translator thereof.

I verify that the attached English translation is a true and correct translation of the amended claims and pages of the specification submitted to the EPO on June 8, 2004 in connection with the PCT application PCT/EP03/07348.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signed:

James G. Morgan

This 21st day of February 2005

Claims

1. Method for the attachment of a functional element (14) having a head end (20) and optionally a shaft part (22), in particular a fastener element, to a sheet metal part (12), optionally in liquid-tight and/or gas-tight form, wherein the functional element is pressed against the sheet metal part (12) supported by a die button having a shaping space (62) and sheet metal material is pressed by means of at least one movably mounted shaped part (50), and preferably by means of at least two such shaped parts (50) of the die button, and by a radially inwardly directed movement of the or each shaped part, into an undercut of the functional element (14), with the or each shaped part forming a respective wall region of the shaping space (62), characterized in that
the or each shaped part (50) is initially radially supported by an envelope surface region of an abutment envelope and is prevented from a radially inwardly directed movement so long until the sheet metal material is drawn by the head end (20) of the functional element (14) into the shaping space (62) for the formation of a pronounced recess (87) at least largely surrounding the head end and is only then released by an axial movement of the envelope surface region of the abutment element past the or each shaped part for the radial movement for the pressing of the sheet metal material into the undercut.

2. Method in accordance with claim 1,
characterized in that
the or each shaped part (50) is rounded at the surfaces (66) facing the sheet metal material at the transition into the wall section (58) form-

ing the shaping space (62) and the said wall section presses the sheet metal material into features of shape (24) at the radially outer side of the head end of the functional element.

3. Method in accordance with claim 1 or claim 2, characterized in that
the or each shaped part (50) has at its surfaces confronting the sheet metal material, at the transition into the wall section forming the shaping space, a rounded radially inwardly directed projection (64) which presses the sheet metal material into an undercut formed at the head end (20) of the element (14), or at the transition from the head end (20) of the functional element (14) into the shaft part (22).

4. Method in accordance with one of the preceding claims, characterized in that
~~the or each shaped part (50) is prevented from the radially inwardly directed movement by an abutment element (68) of the die button (10) which is biased in the direction towards the sheet metal part and against which the or each shaped part is supported and in that~~ the abutment element is urged back by the head end (20) of the functional element (14) through the intermediary of the sheet metal material (12) during the formation of the recess (87) until the support of the or each shaped part at the abutment element is removed.

5. Method in accordance with one of the preceding claims, characterized in that
the shaped parts (5ß) after the freeing of the radially inwardly directed movement slide under the pressure of the plunger on respective guide tracks (44) inclined to the longitudinal axis (30) of the die button and are thus simultaneously moved axially and radially.

6. Method in accordance with claim 4 and claim 5,
characterized in that
after the attachment of the functional element (14) to the sheet metal part (12), the shaped parts (50) are moved in the axial direction by the biased abutment element (68), with the component assembly formed by the functional element and the sheet metal part, which is also axially moved by the abutment element (68) being released and the axial movement of the component assembly optionally causing a radially outwardly directed movement of the shaped parts permitted by the inclined guide tracks (44).

7. Method in accordance with one of the preceding claims,
characterized in that
sheet metal material is brought by means of the shaped parts (50) into engagement with features (24) providing security against rotation, in particular groove-like and/or rib-like features formed on the functional element (14).

8. Method in accordance with one of the preceding claims,
characterized in that
the sheet metal part (12) is not perforated and not pierced, at least in the region of the functional element (14) during its attachment to the sheet metal part.

9. Method in accordance with one of the claims 1 to 7,
characterized in that
a pre-holed sheet metal part is used and/or in that the sheet metal part is pierced during the attachment of the functional element by

means of a self-piercing functional element or a preceding hole punch.

10. Die button (10), in particular for use in the method in accordance with one of the claims 1 to 9 for the attachment of a functional element having a head end (20) and optionally a shaft part (22), in particular a fastener element (14), to a sheet metal part (12), optionally in liquid-tight and/or gas-tight form, wherein the die button (10) has a die button body (40) with at least one shaped part (50) movably mounted therein, preferably at least two such shaped parts and also an ~~biased~~ abutment element (68) biased in the direction towards the sheet metal part (12) for the or each shaped part at the centre of the die button body and wherein the or each shaped part (50) forms a wall region of a shaping space (62) which is provided in the die button in the region of its end face confronting the sheet metal part and is guided by a respective obliquely positioned guide track (44) for a radially inwardly directed movement, which leads to the sheet metal material being pressed into a feature or shape (24), i.e. into an undercut of the functional element,
characterized in that
~~the abutment element (68) is biased in the direction towards the sheet metal part (12), in that~~ each shaped part (50) is radially supported on an envelope surface region of the abutment element (68) during the formation of a recess (62) in the sheet metal part which takes place in the shaping space (62) of the die button by pressure exerted onto the head end (20) of the functional element (14) and is hereby prevented from the radially inwardly directed movement so long until the envelope surface region of the abutment element (68) against which each shaped part (50) is supported is moved by the said pressure from the head end (20) of the functional element (14)

against the bias past the shaped part and has released the radial movement of the shaped part.

11. Die button in accordance with claim 10,
characterized in that,
after the movement of the abutment element (68) past the shaped part (50), the obliquely disposed guide tracks (44) lead, as a result of the pressure on the sheet metal part, to the radially inwardly directed movement of the shaped parts with simultaneous axial movement of the same.

12. Die button in accordance with claim 10 or 11,
characterized in that
the axial length of the region of the abutment element (68) which prevents the shaped parts (50) from the radially inwardly directed movement is so dimensioned that the recess (87) formed by the head end of a functional element in the shaping space (62) of the sheet metal part at least largely surrounds the head end (20) before the support of the shaped parts at this region is removed by sliding this region past the shaped parts and the radial movement of the shaped parts is freed.

13. Die button in accordance with one of the claims 10 to 12,
characterized in that
the shaped parts (50) are rounded at their surfaces (66) confronting the sheet metal material (12) at the transition into the wall sections (58) forming the shaping space (62).

14. Die button in accordance with one of the claims 10 to 13,
characterized in that

the shaped parts (50) have, at their surfaces (66) confronting the sheet metal material (12) at the transition into the wall sections (58) forming the shaping space (62), radially inwardly directed projections (64) which press the sheet metal material into an undercut (24) formed at the head end (20), or at the transition of the head end (20) of the functional element (14) into the shaft part (22).

15. Die button in accordance with one of the preceding claims 10 to 14, characterized in that
there is provided, for each shaped part (50) there is provided a guide track (44) resembling a T-groove inclined towards the longitudinal axis (30) of the die button in which it slides after freeing of the radially inwardly directed movement under the pressure of a plunger (16) and is thus simultaneously axially and radially moved.

16. Die button in accordance with one of the preceding claims 10 to 15, characterized in that
the shaping space (62) is also formed by fixedly arranged wall regions (60) of the die button body (40) which are each arranged between two movable shaped parts (50) of the die button.

17. Die button in accordance with claim 16,
characterized in that,
in the starting state prior to generation of the recess (87) in the sheet metal part, the fixedly arranged wall regions (60) of the die button body are aligned with or offset fractionally in front of or behind the wall regions (58) of the shaped parts (50) which co-define the shaping space (62), whereas, in the closed state of the die button, after the completion of the connection between the functional element and the sheet metal part, they are significantly set back relative to the radially

inwardly advanced wall regions (58) of the shaped parts (50) which co-define the shaping space (62).

18. Die button in accordance with one of the claims 10 to 17, characterized in that
for the biasing of the abutment element (68) in the axial direction towards the sheet metal part (12) a spring (72) disposed in a hollow cavity of the die button is provided.

19. Die button in accordance with claim 18, characterized in that
the abutment element (68) has, at its end confronting the spring (72), a radial shoulder (70) which comes into contact with a shoulder (74) of the die button and hereby limits the maximum movement of the abutment element (68) towards the sheet metal part (12).

20. Die button in accordance with claim 19, characterized in that
the spring (72) is supported at its end remote from the abutment element (68) on an abutment (82) fixed in the die button.

21. Die button in accordance with claim 20, characterized in that
the spring (72) is pre-stressed between the shoulder (70) of the abutment element (68) and a shoulder of the abutment (82).

22. Die button in accordance with claim 20 or claim 21, characterized in that
the abutment (82) is held in a longitudinal bore of the die button by means of a spring ring (84).

23. Die button in accordance with one of the claims 10 to 22, characterized in that
the abutment element (68) has a front pin part (76) the free end face (78) of which can be loaded by the head end (20) of a functional element (14), optionally through the intermediary of the sheet metal part, for the axial movement of the abutment element (68).

24. Die button in accordance with one of the claims 10 to 23, characterized in that
the end faces of the shaped parts (50) confronting the sheet metal part (12) projects, up to the conclusion of the radially inwardly directed movement of the shaped parts (50), beyond the end face (46) of the die button (40).

25. Die button in accordance with claim 24, characterized in that
at the conclusion of the radial inwardly directed movement of the shaped parts (50) these are flush with the end face (46) of the die button body.

~~Abstract of Disclosure~~

~~The invention relates to a method for the attachment of a functional element having a head end and optionally a shaft part, in particular a fastener element, to a sheet metal part, optionally in liquid tight and/or gas tight form, wherein the functional element is pressed against the sheet metal part supported by a die button having a shaping space and sheet metal material is pressed by means of at least one movably mounted shaped part and by a radially inwardly directed movement of the shaped part into an undercut of a functional element, with the shaped part(s) forming a respective wall region of the shaping space, characterized in that the or each shaped part is prevented from a radially inwardly directed movement so long until the sheet metal material is drawn by the head end of the functional element into the shaping space for the formation of a pronounced recess at least largely surrounding the head end and is only then released for the radial movement for the pressing of the sheet metal material into the undercut.~~

Method and also die button for the attachment of a functional element to a sheet metal part

The present invention relates to a method for the attachment of a functional element having a head end and optionally a shaft part, in particular a fastener element, to a sheet metal part, optionally in liquid-tight and/or gas-tight form, wherein the functional element is pressed against the sheet metal part supported by a die button having a shaping space and sheet metal material is pressed by means of at least one movably mounted shaped part, and preferably by means of at least two such shaped parts of the die button and by a radially inwardly directed movement of the or each shaped part, into an undercut of the functional element, with the or each shaped part forming a respective wall region of the shaping space. Furthermore, the invention relates to a die button, in particular for use in such a method for the attachment of a functional element having a head end and optionally a shaft part, in particular a fastener element, to a sheet metal part, optionally in liquid-tight and/or gas-tight form, wherein the die button has a die button body with at least one shaped part movably mounted therein, preferably at least two such shaped parts and also an ~~biased~~ abutment element biased in the direction towards the sheet metal part for the or each shaped part at the centre of the die button body and wherein the or each shaped part forms a wall region of a shaping space which is provided in the die button in the region of its end face confronting the sheet metal part and is guided by a respective obliquely positioned guide track for a radially inwardly directed movement, which leads to the sheet metal material being pressed into a feature of shape, i.e. into an undercut of the functional element.

A method and a die button of this kind is known from European patent application EP-A-0993 902~~99 120 559.2~~. There a method of this kind and

a die button of this kind are used in order to attach different functional elements to a sheet metal part. For example, the functional element can be an element in accordance with Figs. 1a and 1b there, where the head part has a larger diameter than the shaft part and an undercut is formed between the head part and shaft part. Furthermore, the functional element can be an element which presents itself, in accordance with Fig. 5 there, as a threaded pin with at least substantially constant diameter. In this connection features providing security against rotation can be provided in the region of the head end of the threaded pin. Alternatively to this, the functional element can be an element in accordance with the German patent application 10118973.7. Furthermore the functional element can be an element which presents itself as a hollow tube element or is formed in accordance with the European patent application EP 02012625.6. Furthermore, the functional element can simply represent a nut element, with the nut body so to say forming the head part of the element.

Important with respect to the shape of the functional element is that one or more undercuts or features of shapes such as recesses exist in the region of the head part or of the part of the element, which is surrounded by the sheet metal part, which are present for a form-fitted engagement with the sheet metal material in the region of a recess of the sheet metal part which forms an attachment of the functional element to the sheet metal part. It is not necessary that the functional element is equipped with a thread. The functional element can, straightforwardly, be an element which is, for example, formed as a guide pin or has a spherical head or is equipped with special features in order to carry out specific functions. As a further example, one can name here a pin which serves in a car to receive a spring clamp for the attachment of a carpet or a brake-line clip or a cable clip.

Furthermore, the functional element can be a hollow body element such as a nut element with our without an internal thread, which itself represents the head part and does not necessarily have a shaft part. The undercut will then, for example, be realized at the transition from the side wall of the element into its exposed end face or by this transition.

It is known to attach functional elements by various methods and using different die buttons to sheet metal parts on an industrial scale. This frequently takes place at the same time as the deformation of the sheet metal part to form a three-dimensional article. It is problematic in all such methods and die buttons that they have to operate reliably over long series.

One problem in the manufacture of sheet metal parts which have a recess in which the head part or a functional element is received in form-fitted manner lies in the fact that the previously known methods or die buttons occasionally lead to a faulty formation of the recess, for example in the sense that the recess is not symmetrically shaped.

The object of the present invention is to so further improve a method or a die button of the initially named kind that the method and the die button operate more reliably and undesired asymmetries or faulty formations of the sheet metal part do not arise, or at most only arise extremely rarely.

In order to satisfy this object provision is made in accordance with the invention, starting from a method of the initially named kind, ~~method-wise in accordance with the invention~~ that ~~the or each shaped part (50) is prevented from a radially inwardly directed movement so long until the sheet metal material is drawn by the head end of the functional element~~

~~into the shaping space for the formation of a pronounced recess at least largely surrounding the head end and is only then released for the radial movement for the pressing of the sheet metal material into the undercut.~~ the or each shaped part is initially radially supported by an envelope surface region of an abutment envelope and is prevented from a radially inwardly directed movement so long until the sheet metal material is drawn by the head end of the functional element into the shaping space for the formation of a pronounced recess at least largely surrounding the head end and is only then released by an axial movement of the envelope surface region of the abutment element past the or each shaped part for the radial movement for the pressing of the sheet metal material into the undercut.

Furthermore, a die button of the initially named kind is likewise ~~a die button is~~ provided in accordance with the invention~~in accordance with the invention which is characterized in that the abutment element is biased in the direction towards the sheet metal part, in that each shaped part is supported on the abutment element during the formation of a recess in the sheet metal part, which takes place in the shaping space of the die button by pressure exerted onto the head end of the functional element and is hereby prevented from the radially inwardly directed movement so long until the region of the abutment element against which each shaped part is supported is moved by the said pressure from the head end of the functional element against the bias passed the shaped part and has released the radial movement of the shaped part.~~ which is characterized in that each shaped part is radially supported on an envelope surface region of the abutment element during the formation of a recess in the sheet metal part which takes place in the shaping space of the die button by pressure exerted onto the head end of the functional element and is hereby prevented from the radially inwardly directed movement so long

until the envelope surface region of the abutment element against which each shaped part is supported is moved by the said pressure from the head end of the functional element against the bias past the shaped part and has released the radial movement of the shaped part.

Since the shaped part or the shaped parts are first immovably held by contact against the abutment element clearly defined conditions for the formation of the recess are present so that one succeeds in forming the recess in an orderly manner without faulty shapes of the recesses having to be feared. Furthermore, the radial movements of the shaped parts which cause the sheet metal material to be pressed into the features of shape or into the undercut of the functional element, are so synchronized by the selected method or by the die button designed in accordance with the invention that a symmetrical deformation of the sheet metal material takes place in the region of the recess around the head end of the functional element, whereby a symmetrical formation of the connection between the sheet metal part and the functional element likewise takes place, without faulty shapes of this connection having to the feared.

Depending on how the functional element is designed the shaped parts can be rounded in accordance with claim 2 at their surfaces confronting the sheet metal material, at the transition to the wall sections forming the shaping space and the said wall sections can press the sheet metal material into features of shape in the radially outer side of the head end of the functional element. Should an undercut be present at the functional element, at the head part or between the head part and the shaft part, then, at their surfaces which confront the sheet metal material, at the transition into the wall sections which form the shaping space, the shaped parts can have rounded, radially inwardly directed projections which press the sheet metal material into the undercut. Here the rounded shape also

serves for the more careful treatment of the sheet metal part so that it is not perforated or pierced.

The method of the invention and the die button of the invention are particularly simply designed ~~when the shaped parts are prevented from their radially inwardly directed movement by an abutment element of the die button which is biased in the direction towards the sheet metal part and on which they are supported and~~ when the abutment element is urged rearwardly by the head end of the functional element through the intermediary of the sheet metal material during the formation of the recess until the support of the shaped parts on the abutment element is removed.

Thus, with a relatively simple design of the abutment element, the abutment element of the die button is urged back during formation of the recess in the sheet metal part until the shaped parts are no longer supported on the abutment element and can move, as a result of the pressure exerted on to the end faces of the shaped parts confronting the sheet metal part, along the obliquely positioned guide tracks. This movement also takes place in synchronized manner because the sheet metal part is simultaneously pressed by the plunger or the setting head onto the end faces of all shaped parts at the same time and itself takes care of the synchronized movement of the shaped parts along the respectively associated, obliquely positioned, guides. Since the shaped parts are moved by the same amount in the axial direction under the action of the setting head which presses against the sheet metal part they all likewise move by the same radial amount in the radial direction because the guide tracks all form the same angle with the longitudinal axis of the die button. In the region of the shaped parts the die button is particularly intimately brought into engagement with features providing security against rotation formed

at the functional element, in particular groove-like and/or knurled-type features, whereby a particularly secure security against rotation takes place.

It is particularly favourable when, for the shaped parts, respective guide tracks resembling T-grooves inclined to the longitudinal axis of the die button are provided in which the shaped parts, ~~slide under the pressure of a plunger~~ after the release of the radially inwardly directed movement,

Claims

1. Method for the attachment of a functional element (14) having a head end (20) and optionally a shaft part (22), in particular a fastener element, to a sheet metal part (12), optionally in liquid-tight and/or gas-tight form, wherein the functional element is pressed against the sheet metal part (12) supported by a die button having a shaping space (62) and sheet metal material is pressed by means of at least one movably mounted shaped part (50), and preferably by means of at least two such shaped parts (50) of the die button, and by a radially inwardly directed movement of the or each shaped part, into an undercut of the functional element (14), with the or each shaped part forming a respective wall region of the shaping space (62), characterized in that
the or each shaped part (50) is initially radially supported by an envelope surface region of an abutment envelope and is prevented from a radially inwardly directed movement so long until the sheet metal material is drawn by the head end (20) of the functional element (14) into the shaping space (62) for the formation of a pronounced recess (87) at least largely surrounding the head end and is only then released by an axial movement of the envelope surface region of the abutment element past the or each shaped part for the radial movement for the pressing of the sheet metal material into the undercut.

2. Method in accordance with claim 1,
characterized in that
the or each shaped part (50) is rounded at the surfaces (66) facing the sheet metal material at the transition into the wall section (58) form-

ing the shaping space (62) and the said wall section presses the sheet metal material into features of shape (24) at the radially outer side of the head end of the functional element.

3. Method in accordance with claim 1 or claim 2,
characterized in that
the or each shaped part (50) has at its surfaces confronting the sheet metal material, at the transition into the wall section forming the shaping space, a rounded radially inwardly directed projection (64) which presses the sheet metal material into an undercut formed at the head end (20) of the element (14), or at the transition from the head end (20) of the functional element (14) into the shaft part (22).

4. Method in accordance with one of the preceding claims,
characterized in that
the abutment element is urged back by the head end (20) of the functional element (14) through the intermediary of the sheet metal material (12) during the formation of the recess (87) until the support of the or each shaped part at the abutment element is removed.

5. Method in accordance with one of the preceding claims,
characterized in that
the shaped parts (5ß) after the freeing of the radially inwardly directed movement slide under the pressure of the plunger on respective guide tracks (44) inclined to the longitudinal axis (30) of the die button and are thus simultaneously moved axially and radially.

6. Method in accordance with claim 4 and claim 5,
characterized in that

after the attachment of the functional element (14) to the sheet metal part (12), the shaped parts (50) are moved in the axial direction by the biased abutment element (68), with the component assembly formed by the functional element and the sheet metal part, which is also axially moved by the abutment element (68) being released and the axial movement of the component assembly optionally causing a radially outwardly directed movement of the shaped parts permitted by the inclined guide tracks (44).

7. Method in accordance with one of the preceding claims, characterized in that
sheet metal material is brought by means of the shaped parts (50) into engagement with features (24) providing security against rotation, in particular groove-like and/or rib-like features formed on the functional element (14).

8. Method in accordance with one of the preceding claims, characterized in that
the sheet metal part (12) is not perforated and not pierced, at least in the region of the functional element (14) during its attachment to the sheet metal part.

9. Method in accordance with one of the claims 1 to 7, characterized in that
a pre-holed sheet metal part is used and/or in that the sheet metal part is pierced during the attachment of the functional element by means of a self-piercing functional element or a preceding hole punch.

10. Die button (10), in particular for use in the method in accordance with one of the claims 1 to 9 for the attachment of a functional element having a head end (20) and optionally a shaft part (22), in particular a fastener element (14), to a sheet metal part (12), optionally in liquid-tight and/or gas-tight form, wherein the die button (10) has a die button body (40) with at least one shaped part (50) movably mounted therein, preferably at least two such shaped parts and also an abutment element (68) biased in the direction towards the sheet metal part (12) for the or each shaped part at the centre of the die button body and wherein the or each shaped part (50) forms a wall region of a shaping space (62) which is provided in the die button in the region of its end face confronting the sheet metal part and is guided by a respective obliquely positioned guide track (44) for a radially inwardly directed movement, which leads to the sheet metal material being pressed into a feature or shape (24), i.e. into an undercut of the functional element,
characterized in that
each shaped part (50) is radially supported on an envelope surface region of the abutment element (68) during the formation of a recess (62) in the sheet metal part which takes place in the shaping space (62) of the die button by pressure exerted onto the head end (20) of the functional element (14) and is hereby prevented from the radially inwardly directed movement so long until the envelope surface region of the abutment element (68) against which each shaped part (50) is supported is moved by the said pressure from the head end (20) of the functional element (14) against the bias past the shaped part and has released the radial movement of the shaped part.

11. Die button in accordance with claim 10,
characterized in that,

after the movement of the abutment element (68) past the shaped part (50), the obliquely disposed guide tracks (44) lead, as a result of the pressure on the sheet metal part, to the radially inwardly directed movement of the shaped parts with simultaneous axial movement of the same.

12. Die button in accordance with claim 10 or 11, characterized in that the axial length of the region of the abutment element (68) which prevents the shaped parts (50) from the radially inwardly directed movement is so dimensioned that the recess (87) formed by the head end of a functional element in the shaping space (62) of the sheet metal part at least largely surrounds the head end (20) before the support of the shaped parts at this region is removed by sliding this region past the shaped parts and the radial movement of the shaped parts is freed.

13. Die button in accordance with one of the claims 10 to 12, characterized in that the shaped parts (50) are rounded at their surfaces (66) confronting the sheet metal material (12) at the transition into the wall sections (58) forming the shaping space (62).

14. Die button in accordance with one of the claims 10 to 13, characterized in that the shaped parts (50) have, at their surfaces (66) confronting the sheet metal material (12) at the transition into the wall sections (58) forming the shaping space (62), radially inwardly directed projections (64) which press the sheet metal material into an undercut (24)

formed at the head end (20), or at the transition of the head end (20) of the functional element (14) into the shaft part (22).

15. Die button in accordance with one of the preceding claims 10 to 14, characterized in that
there is provided, for each shaped part (50) there is provided a guide track (44) resembling a T-groove inclined towards the longitudinal axis (30) of the die button in which it slides after freeing of the radially inwardly directed movement under the pressure of a plunger (16) and is thus simultaneously axially and radially moved.

16. Die button in accordance with one of the preceding claims 10 to 15, characterized in that
the shaping space (62) is also formed by fixedly arranged wall regions (60) of the die button body (40) which are each arranged between two movable shaped parts (50) of the die button.

17. Die button in accordance with claim 16,
characterized in that,
in the starting state prior to generation of the recess (87) in the sheet metal part, the fixedly arranged wall regions (60) of the die button body are aligned with or offset fractionally in front of or behind the wall regions (58) of the shaped parts (50) which co-define the shaping space (62), whereas, in the closed state of the die button, after the completion of the connection between the functional element and the sheet metal part, they are significantly set back relative to the radially inwardly advanced wall regions (58) of the shaped parts (50) which co-define the shaping space (62).

18. Die button in accordance with one of the claims 10 to 17,

characterized in that
for the biasing of the abutment element (68) in the axial direction towards the sheet metal part (12) a spring (72) disposed in a hollow cavity of the die button is provided.

19. Die button in accordance with claim 18,
characterized in that
the abutment element (68) has, at its end confronting the spring (72), a radial shoulder (70) which comes into contact with a shoulder (74) of the die button and hereby limits the maximum movement of the abutment element (68) towards the sheet metal part (12).

20. Die button in accordance with claim 19,
characterized in that
the spring (72) is supported at its end remote from the abutment element (68) on an abutment (82) fixed in the die button.

21. Die button in accordance with claim 20,
characterized in that
the spring (72) is pre-stressed between the shoulder (70) of the abutment element (68) and a shoulder of the abutment (82).

22. Die button in accordance with claim 20 or claim 21,
characterized in that
the abutment (82) is held in a longitudinal bore of the die button by means of a spring ring (84).

23. Die button in accordance with one of the claims 10 to 22,
characterized in that

the abutment element (68) has a front pin part (76) the free end face (78) of which can be loaded by the head end (20) of a functional element (14), optionally through the intermediary of the sheet metal part, for the axial movement of the abutment element (68).

24. Die button in accordance with one of the claims 10 to 23, characterized in that
the end faces of the shaped parts (50) confronting the sheet metal part (12) projects, up to the conclusion of the radially inwardly directed movement of the shaped parts (50), beyond the end face (46) of the die button (40).

25. Die button in accordance with claim 24, characterized in that
at the conclusion of the radial inwardly directed movement of the shaped parts (50) these are flush with the end face (46) of the die button body.

Method and also die button for the attachment of a functional element to a sheet metal part

The present invention relates to a method for the attachment of a functional element having a head end and optionally a shaft part, in particular a fastener element, to a sheet metal part, optionally in liquid-tight and/or gas-tight form, wherein the functional element is pressed against the sheet metal part supported by a die button having a shaping space and sheet metal material is pressed by means of at least one movably mounted shaped part, and preferably by means of at least two such shaped parts of the die button and by a radially inwardly directed movement of the or each shaped part, into an undercut of the functional element; with the or each shaped part forming a respective wall region of the shaping space. Furthermore, the invention relates to a die button, in particular for use in such a method for the attachment of a functional element having a head end and optionally a shaft part, in particular a fastener element, to a sheet metal part, optionally in liquid-tight and/or gas-tight form, wherein the die button has a die button body with at least one shaped part movably mounted therein, preferably at least two such shaped parts and also an abutment element biased in the direction towards the sheet metal part for the or each shaped part at the centre of the die button body and wherein the or each shaped part forms a wall region of a shaping space which is provided in the die button in the region of its end face confronting the sheet metal part and is guided by a respective obliquely positioned guide track for a radially inwardly directed movement, which leads to the sheet metal material being pressed into a feature of shape, i.e. into an undercut of the functional element.

A method and a die button of this kind is known from European patent application EP-A-0993 902. There a method of this kind and a die button

of this kind are used in order to attach different functional elements to a sheet metal part. For example, the functional element can be an element in accordance with Figs. 1a and 1b there, where the head part has a larger diameter than the shaft part and an undercut is formed between the head part and shaft part. Furthermore, the functional element can be an element which presents itself, in accordance with Fig. 5 there, as a threaded pin with at least substantially constant diameter. In this connection features providing security against rotation can be provided in the region of the head end of the threaded pin. Alternatively to this, the functional element can be an element in accordance with the German patent application 10118973.7. Furthermore the functional element can be an element which presents itself as a hollow tube element or is formed in accordance with the European patent application EP 02012625.6. Furthermore, the functional element can simply represent a nut element, with the nut body so to say forming the head part of the element.

Important with respect to the shape of the functional element is that one or more undercuts or features of shapes such as recesses exist in the region of the head part or of the part of the element, which is surrounded by the sheet metal part, which are present for a form-fitted engagement with the sheet metal material in the region of a recess of the sheet metal part which forms an attachment of the functional element to the sheet metal part. It is not necessary that the functional element is equipped with a thread. The functional element can, straightforwardly, be an element which is, for example, formed as a guide pin or has a spherical head or is equipped with special features in order to carry out specific functions. As a further example, one can name here a pin which serves in a car to receive a spring clamp for the attachment of a carpet or a brake-line clip or a cable clip.

Furthermore, the functional element can be a hollow body element such as a nut element with our without an internal thread, which itself represents the head part and does not necessarily have a shaft part. The undercut will then, for example, be realized at the transition from the side wall of the element into its exposed end face or by this transition.

It is known to attach functional elements by various methods and using different die buttons to sheet metal parts on an industrial scale. This frequently takes place at the same time as the deformation of the sheet metal part to form a three-dimensional article. It is problematic in all such methods and die buttons that they have to operate reliably over long series.

One problem in the manufacture of sheet metal parts which have a recess in which the head part or a functional element is received in form-fitted manner lies in the fact that the previously known methods or die buttons occasionally lead to a faulty formation of the recess, for example in the sense that the recess is not symmetrically shaped.

The object of the present invention is to so further improve a method or a die button of the initially named kind that the method and the die button operate more reliably and undesired asymmetries or faulty formations of the sheet metal part do not arise, or at most only arise extremely rarely.

In order to satisfy this object provision is made in accordance with the invention, starting from a method of the initially named kind, that the or each shaped part is initially radially supported by an envelope surface region of an abutment envelope and is prevented from a radially inwardly directed movement so long until the sheet metal material is drawn by the head end of the functional element into the shaping space for the forma-

tion of a pronounced recess at least largely surrounding the head end and is only then released by an axial movement of the envelope surface region of the abutment element past the or each shaped part for the radial movement for the pressing of the sheet metal material into the undercut.Furthermore, a die button of the initially named kind is likewise provided in accordance with the invention which is characterized in that each shaped part is radially supported on an envelope surface region of the abutment element during the formation of a recess in the sheet metal part which takes place in the shaping space of the die button by pressure exerted onto the head end of the functional element and is hereby prevented from the radially inwardly directed movement so long until the envelope surface region of the abutment element against which each shaped part is supported is moved by the said pressure from the head end of the functional element against the bias past the shaped part and has released the radial movement of the shaped part.

Since the shaped part or the shaped parts are first immovably held by contact against the abutment element clearly defined conditions for the formation of the recess are present so that one succeeds in forming the recess in an orderly manner without faulty shapes of the recesses having to be feared. Furthermore, the radial movements of the shaped parts which cause the sheet metal material to be pressed into the features of shape or into the undercut of the functional element, are so synchronized by the selected method or by the die button designed in accordance with the invention that a symmetrical deformation of the sheet metal material takes place in the region of the recess around the head end of the functional element, whereby a symmetrical formation of the connection between the sheet metal part and the functional element likewise takes place, without faulty shapes of this connection having to the feared.

Depending on how the functional element is designed the shaped parts can be rounded in accordance with claim 2 at their surfaces confronting the sheet metal material, at the transition to the wall sections forming the shaping space and the said wall sections can press the sheet metal material into features of shape in the radially outer side of the head end of the functional element. Should an undercut be present at the functional element, at the head part or between the head part and the shaft part, then, at their surfaces which confront the sheet metal material, at the transition into the wall sections which form the shaping space, the shaped parts can have rounded, radially inwardly directed projections which press the sheet metal material into the undercut. Here the rounded shape also serves for the more careful treatment of the sheet metal part so that it is not perforated or pierced.

The method of the invention and the die button of the invention are particularly simply designed when the abutment element is urged rearwardly by the head end of the functional element through the intermediary of the sheet metal material during the formation of the recess until the support of the shaped parts on the abutment element is removed.

Thus, with a relatively simple design of the abutment element, the abutment element of the die button is urged back during formation of the recess in the sheet metal part until the shaped parts are no longer supported on the abutment element and can move, as a result of the pressure exerted on to the end faces of the shaped parts confronting the sheet metal part, along the obliquely positioned guide tracks. This movement also takes place in synchronized manner because the sheet metal part is simultaneously pressed by the plunger or the setting head onto the end faces of all shaped parts at the same time and itself takes care of the synchronized movement of the shaped parts along the respectively associ-

ated, obliquely positioned, guides. Since the shaped parts are moved by the same amount in the axial direction under the action of the setting head which presses against the sheet metal part they all likewise move by the same radial amount in the radial direction because the guide tracks all form the same angle with the longitudinal axis of the die button. In the region of the shaped parts the die button is particularly intimately brought into engagement with features providing security against rotation formed at the functional element, in particular groove-like and/or knurled-type features, whereby a particularly secure security against rotation takes place.

It is particularly favourable when, for the shaped parts, respective guide tracks resembling T-grooves inclined to the longitudinal axis of the die button are provided in which the shaped parts, after the release of the radially inwardly directed movement,